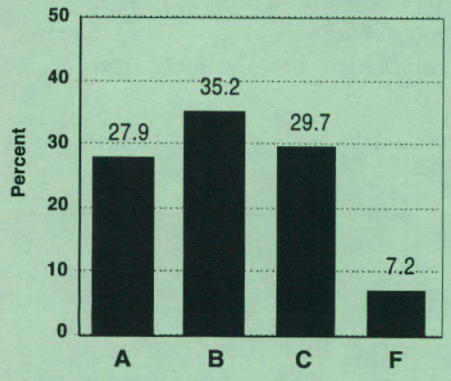
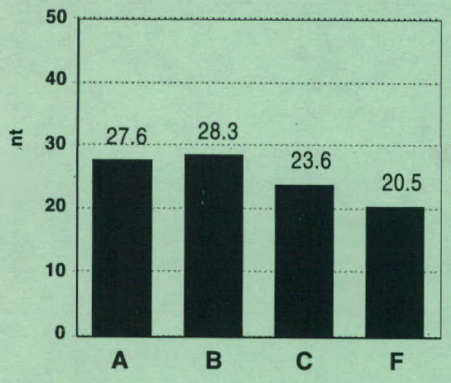
Biology 30

Diploma Examination Results
Examiners' Report for June 1995

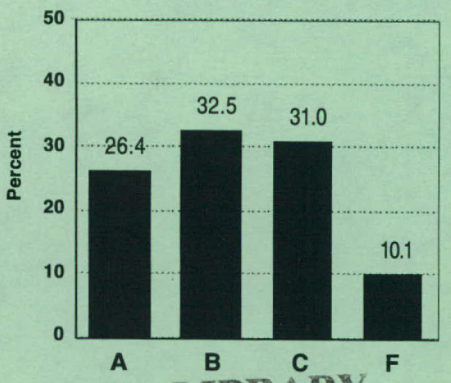
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1995 administration of the Biology 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Biology 30 examination consists of 48 multiple-choice questions worth 60%, 8 numerical-response questions worth 10%, and 2 written-response questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 9 366 students in Alberta who wrote the June 1995 examination. This represents a decrease of 147 students compared with June 1994, and a decrease of 2 684 students compared with June 1993.

- 89.9% of the 9 366 students achieved the acceptable standard (a final course mark of 50% or higher).
- 26.4% of the 9 366 students achieved the standard of excellence (a final course mark of 80% or higher).

Generally, student achievement in Biology 30 was very good. Although the implementation of the new program of studies for Biology 30 makes comparisons with past years difficult, the percentage of students who achieved the acceptable standard (89.9%) was slightly higher than for June 1994 (88.1%). Most students demonstrated a good understanding of how the human nervous and endocrine systems maintain equilibrium internally and with the external environment. They demonstrated a very good understanding of how human reproductive systems are chemically regulated. The majority of students were able to describe and evaluate scientific research procedures that extend our knowledge of the relationships between populations and ecological parameters. Some students had difficulty with concepts related to molecular genetics, particularly in the context of how technology has supported scientific research.

Approximately 60.5% of the students who wrote the examination were female. Of this female population, approximately 79.4% achieved the acceptable standard on the examination, compared with 79.6% of the male population. The standard of excellence was achieved by approximately 26.9% of this female population, compared with 28.8% of the male population.

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Student Evaluation

Alberta
EDUCATION

Provincial Averages

- The average school-awarded mark was 69.2%.
- The average diploma examination mark was 66.1%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 68.0%.

Approximately 8.9% of the students who wrote the examination in June 1995 and received a school-awarded mark had written at least one other Biology 30 Diploma Examination during the January 1994 to January 1995 period. This subpopulation (835) achieved an examination average of 56.8%, compared with 67.0% for the population (8 531) who first wrote a Biology 30 examination in June 1995. However, the group of students who rewrote (835) increased their examination average score from 50.3% to 56.8%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard will obtain a mark of 50% or higher and students achieving the standard of excellence will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the percentage of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score achieved by students who wrote the examination.

Questions are also classified by general learner expectations.

Knowledge:

- GLE 1 Nervous & Endocrine Systems
- GLE 2 Reproductive Systems & Hormones
- GLE 3 Differentiation & Development
- GLE 4 Cell Division & Mendelian Genetics
- GLE 5 Molecular Genetics
- GLE 6 Population Genetics & Interaction

Skills:

- SPSC Scientific Process Skills and Communication Skills.

Science, Technology, Society:

- STS Connections Among Science, Technology, & Society.

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC 1	D	76.5	√							
MC 2	B	76.4	√							√
MC 3	C	67.4	√							
MC 4	A	64.5	√							√
MC 5	D	73.6	√							
MC 6	A	77.5	√							
MC 7	C	65.0	√							
MC 8	D	81.1	√							√
MC 9	B	67.1	√							
MC 10	A	68.5	√							
MC 11	D	67.8	√							
NR 1	1143/1928	55.1	√							
MC 12	D	79.9	√							
MC 13	A	71.8	√							√
MC 14	A	80.0	√							
MC 15	D	52.1	√							√
NR 2	4278	55.6		√					√	
MC 16	A	68.0		√						
MC 17	B	74.2		√						√

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC18	D	62.0		√					√	
MC19	A	81.7		√						
MC20	B	73.4			√					
MC21	D	47.3				√				
MC22	C	80.3			√					
MC23	D	79.3			√					
MC24	D	63.9			√					
MC25	C	58.9			√					
MC26	C	79.6			√				√	
NR3	4123	81.4				√			√	
MC27					Deleted*					
NR4	3287	36.4					√		√	
MC28	B	75.6					√			
NR5	7712	73.8					√		√	
MC29	B	84.5					√			
MC30	C	60.9					√			√
MC31	D	39.0					√			√
MC32	B	70.5						√		
MC33	C	55.6						√		
MC34	B	82.4						√	√	
NR6	3840	76.4						√	√	
MC35	C	81.2						√	√	
MC36	B	74.6						√	√	
MC37	A	28.8						√	√	√
MC38	D	82.1						√		√
MC39	B	78.8				√			√	
NR7	0.50	80.2				√			√	
MC40	C	49.8				√				√
MC41	A	68.7				√			√	
NR8	0.50	69.0				√			√	
MC42	C	74.6				√			√	
MC43	B	66.5				√			√	
MC44	A	72.0				√			√	
MC45	C	55.0				√			√	
MC46	B	76.2				√				
MC47	C	52.2				√				
MC48	A	69.4				√			√	
WR1		64.0				√	√	√	√	√
WR2		56.9	√	√	√	√	√		√	√

Subtest: Multiple Choice and Numerical Response

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

- Multiple choice and numerical response: 37.6 out of 55
- General Learner Expectations

GLE 1	Nervous & Endocrine Systems	11.2	out of	16
GLE 2	Reproductive Systems & Hormones	3.4	out of	5
GLE 3	Differentiation & Development	4.4	out of	6
GLE 4	Cell Division & Mendelian Genetics	9.4	out of	14
GLE 5	Molecular Genetics	3.7	out of	6
GLE 6	Population Genetics & Interaction	5.5	out of	8
Skills		13.7	out of	20
STS		6.8	out of	11

- Multiple choice: 32.4 out of 47
- Numerical response: 5.3 out of 8

Subtest: Written Response

Results are in average raw scores.

- Written Response: 14.5 out of 24
- Question 1: 7.7 out of 12
- Question 2: 6.8 out of 12

****Deleted***

Multiple-choice question 27 was deleted because the term "diploid," as defined by some current texts, does not correctly describe stage T if the assumption is made that the sequence of stages R through W, as depicted by the graph, represents meiosis. Current texts, including *Biology*, Nelson Canada, 1993, describe the cells produced by meiosis I as haploid. For a more detailed explanation, refer to page 33, *1995–96 School Year Biology 30 Information Bulletin Diploma Examinations Program*.

A Treatment for Pancreatitis

Surgical removal of the pancreas is a procedure that doctors use to relieve the pain of patients suffering from chronic pancreatitis (inflammation of the pancreas). Unfortunately, the surgery causes the onset of diabetes mellitus and other complications in these patients. In a recent study involving five individuals who had undergone this treatment, islet cells from the removed pancreas were infused (transplanted) back into the liver of each patient. This procedure effectively eliminated the occurrence of diabetes in these patients.

15. Patients who participated in this study no longer have a pancreas. To maintain normal body functions in these patients, the infusion of islet cells would have to be accompanied by daily

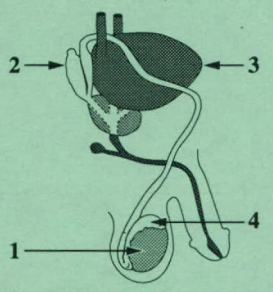
A. ingestion of glycogen to stimulate liver function

B. injection of hormones to promote glycogen release from the liver

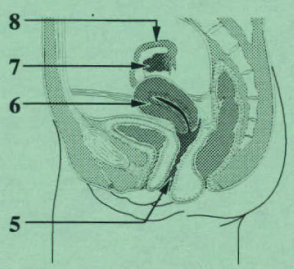
C. injection of digestive enzymes into the blood to maintain nutrient levels

•D. ingestion of digestive enzymes to replace those produced by the pancreas

Reproductive System of a Human Male



Reproductive System of a Human Female



Numerical Response

2. Select the number that identifies each male or female structure described below.

Structure:	_____	_____	_____	_____
Description:	Stores mature sperm	Produces non-cellular components of seminal fluid	Produces ova	Normal site of fertilization

Answer: 4278

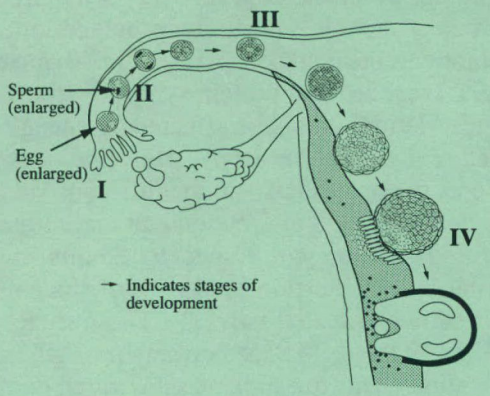
(Record your four-digit answer in the numerical-response section of the answer sheet.)

Multiple-Choice and Numerical-Response Questions

Multiple-choice question 15 required students to analyze the use of a technology and to determine an action that would ameliorate a side-effect created by its use. Most students (80% selected alternative A for question 14) understood the role of the islet cells in regulating sugar levels. However, by selecting either alternative A or B for question 15, (37.2% of the students) many students demonstrated that they did not understand the exocrine function of the pancreas, or they did not understand the result of the islet cell infusion. Students who selected alternative C (10.5% of the students) did not understand the difference between injection and ingestion of digestive enzymes. Students who correctly selected alternative D (52.0% of the students) were able to carry forward a prerequisite concept from Unit IV of Biology 20 to Biology 30. Of the students who achieved the standard of excellence on the examination, 73.3% correctly selected alternative D.

Numerical-response question 2 required students to identify the locations where various reproductive functions occur. An analysis of the responses created by students indicated that almost all students (97.7%) kne that the ovaries produce ova. Several common misconceptions were revealed. About 28.0% of students indicated that the testes store mature sperm, and approximately 15.6% of students thought that the uterus was the normal site of fertilization. About 5.3% of students indicated that the urinary bladder produces non-cellular components of semen; approximately 5.9% of students attributed this function to the epididymis. Of the students who achieved the standard of excellence on the examination, 85.9% correctly identified all four locations.

Some Early Stages in the Development of a Human Fetus



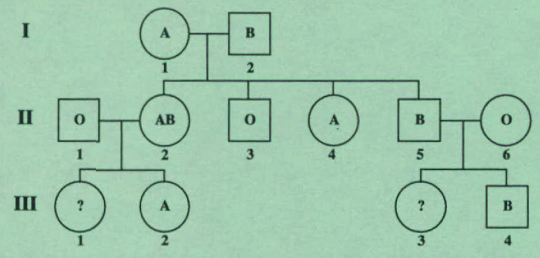
21. At the completion of each successive cell division during stage III, the

A. volume of cytoplasm per cell is increased
B. number of chromosomes per cell is doubled
C. number of chromosomes per cell is reduced by half
•**D.** cytoplasmic contents are approximately equally distributed

Multiple-choice question 21 required students to identify a characteristic of one type of cell division. The concepts assessed in questions 20 and 21 are linked. In question 20, 73.4% of students correctly identified the type of cell division in Stage III as mitosis, yet, for question 21, 44.1% of students chose either alternative B or C. These students did not read the question carefully, or think carefully about the process of mitosis. Daughter cells produced by mitosis have the same chromosome number as a mother cell but the cytoplasmic content of a mother cell is divided between the newly formed daughter cells. Detailed knowledge of blastocyst development was not required, but assessing the concept of mitosis in the context of embryo development seemed to confuse many students. However, of the students who achieved the standard of excellence on the examination, 81.6% correctly selected alternative D.

A Family Pedigree of ABO Blood Types

ABO blood types are shown in the pedigree symbols. Question marks indicate individuals of unknown blood type.



41. A valid conclusion based on the pedigree is that

•**A.** individuals I 1 and I 2 both carry the allele i
B. individual II 3 would be unable to father children with type B blood
C. individual II 4 is homozygous for the allele I^A
D. individuals III 2 and III 4 are both homozygous for blood type alleles

Multiple-choice question 41 required students to analyze a pedigree to determine the genotype or phenotype of various individuals. About 22.1% of the students incorrectly chose either alternative C or D. It is likely that these students did not know the meaning of the word homozygous, or could not determine the genotype of the requested individuals because they were uncertain about the genotype of the individuals' parents. It is evident that many students failed to begin their analyses of the pedigree by determining which individuals were homozygous-recessive. This question was answered correctly by 91.7% of the students who achieved the standard of excellence on the examination.

Numerical Response

8. A man of unknown genotype with blood type A and a woman with blood type O are going to have a child. Depending on the man's genotype, the minimum probability that the child will have blood type O is zero. What is the maximum probability that the child will have blood type O?

Answer: 0.50

(Record a value from 0 to 1, rounded to two significant digits, in the numerical-response section of the answer sheet.)

Numerical-response question 8 required students to predict the probability of certain parents having a child with a particular phenotype. If the father is homozygous (I^AI^A), he cannot have children that are blood type O, thus the minimum probability of 0. If the father is heterozygous (I^Ai) and the mother has the genotype ii , the maximum probability of their child having blood type O is 0.50. About 11.2% of the students predicted the maximum probability to be 0.25. These students may have incorrectly determined a combined probability (the average of the minimum and the maximum probabilities) or used an incorrect genotype for the mother. Less than 2% of the students recorded their answer as a percentage. This question was answered correctly by 93.5% of the students who achieved the standard of excellence on the examination.

Antibiotics are chemicals produced by some micro-organisms to provide a defense against bacterial infection. Many antibiotics block or disrupt one or more stages in protein synthesis by bacteria. A few antibiotics inhibit cell division in bacteria. Some common antibiotics are described below.

Antibiotic	Description
1. Chloramphenicol	• Prevents the normal joining of mRNA with ribosomes • Inhibits the reaction that leads to the formation of bonds between amino acids
2. Streptomycin	• Causes misreading of the genetic code in mRNA
3. Puromycin	• Binds with the amino acid tyrosine and substitutes for the tRNA-tyrosine complex on ribosomes • Prevents the further addition of amino acids to a polypeptide when tyrosine is required
4. Actinomycin	• Binds to DNA nucleotides • Inhibits the linking of nucleotides in mRNA or DNA
5. Tetracycline	• Prevents binding of tRNA to the first codon in a mRNA molecule
6. Mechlorethamine	• Binds to guanine in cytosine-guanine base pairs

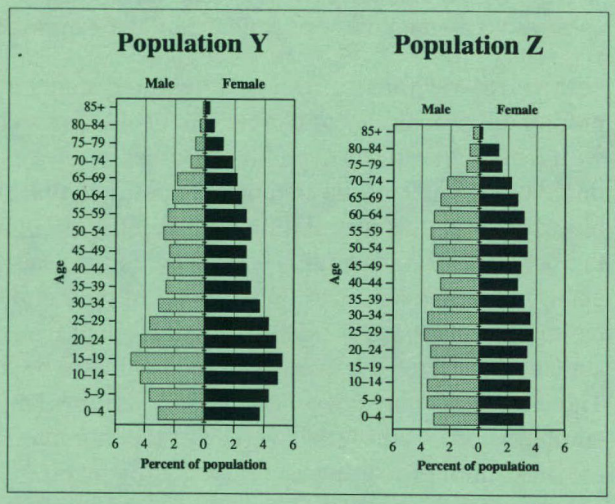
30. Some antibiotics do not prevent the synthesis of protein by bacterial cells but do cause the cells to produce abnormal proteins. Two such antibiotics are numbered

A. 1 and 2
B. 1 and 4
•**C.** 2 and 3
D. 3 and 4

31. Two antibiotics that likely prevent the replication of bacterial DNA just before cell division begins are numbered

A. 2 and 5
B. 2 and 6
C. 4 and 5
•**D.** 4 and 6

Multiple-choice questions 30 and 31 required students to apply knowledge of the processes of replication, transcription, and translation to the actions of antibiotics on bacterial cells. This required careful analysis of the role description provided for each antibiotic in the context. In question 30, most students (60.9%) realized that protein synthesis (transcription and translation) would be affected by changes in the structure of mRNA or tRNA. However, many students did not understand the difference between complete blockage of function and inaccurate or modified function with respect to the implications for translation. In question 31, 42.5% of students incorrectly chose alternative C. These students could not discern the difference between translation and replication. This question was answered correctly by 67.5% of the students who achieved the standard of excellence on the examination.



37. The impact of birth control technologies on a human population is best shown by population graph

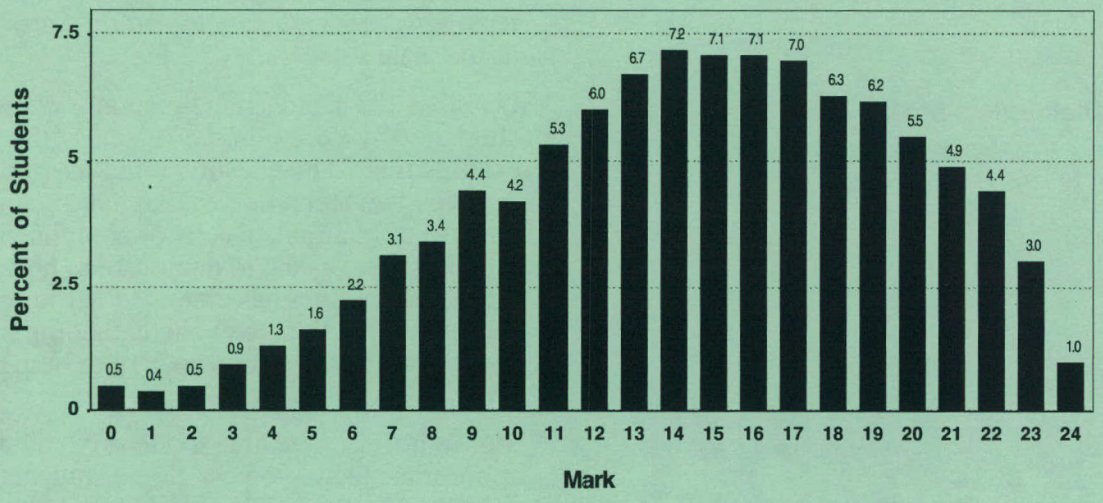
•**A.** Y, ages 0 to 14
B. Y, ages 30 to 49
C. Z, ages 0 to 14
D. Z, ages 30 to 49

Multiple-choice question 37 required students to analyze data about two populations to determine which population was most affected by the use of birth control technologies. Approximately 56.7% of the students chose population graph Y. To determine the correct answer, students had to compare the proportion of females in the reproductive age categories (ages 15–34) to the proportion of children (ages 0–14) in the population. Compared to population Z, the large number of females of reproductive age in population Y produced few children. Only 28.8% of students correctly chose alternative A. The students (about 38.9% of the population) who incorrectly selected the age range 30–49 for either population Y or Z may have confused declining reproductive capacity caused by age with the effect of the use of birth control technologies. This question was answered correctly by 47.4% of the students who achieved the standard of excellence on the examination.

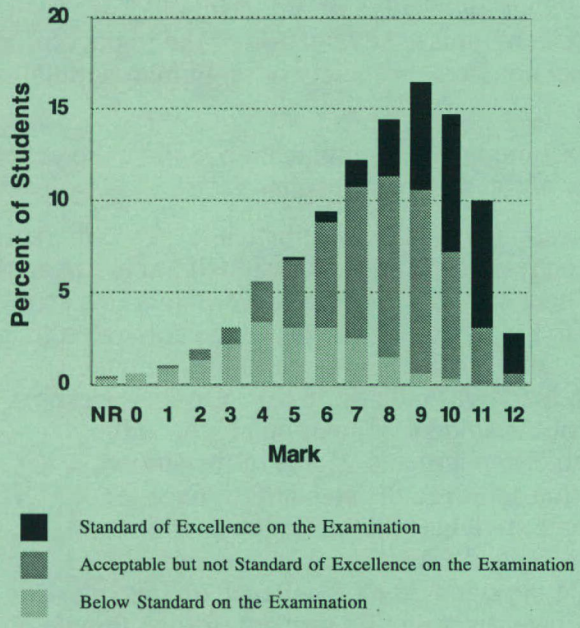
Written-Response Questions

Responses to the written-response questions indicated that most students approached the examination seriously. Of the students who wrote the examination, 0.5% received no marks for both written-response questions, 72.3% received 12 marks or more out of 24, and 18.9% received 20 marks or more out of 24.

Distribution of Marks for Written Response



Distribution of Marks for Question 1



Question 1: This process skill question, which related to a research study of the growth of three varieties of canola in different environmental conditions, was attempted by almost all students (99.6%) who wrote the examination.

Most of the subparts of the question required students to analyze data and then provide conclusions or hypotheses that could be inferred from the data.

In part *a*, most students were able to present at least two conclusions based on information extracted from a graph. Many students displayed a lack of understanding of the use of a logarithmic scale on a graph.

In part *b*, most students demonstrated an understanding of the concept of competition.

In part *c*, most students were able to identify fixed and manipulated variables used in the research study.

In part *d*, most students demonstrated an awareness of the risks and benefits of genetic engineering.

Many students did not attempt part *e*. Those who did, demonstrated good mathematical skills.

In part *f*, some students did not recognize the use of Charlock as a fixed variable.

In part *g*, some students were unable to distinguish between a hypothesis and a conclusion.

On this 12-mark question, the average mark was 7.69 or 64.1%. The acceptable standard on this question was achieved by 80.0% of the student population with 27.5% achieving the standard of excellence. There was little difference between the achievement of the female students who attempted this question and that of the male students.

Question 2: This extended-response question was attempted by 96.4% of the students who wrote the examination. The question required students to describe two technologies that have been developed to observe or manipulate cells or components of cells. Students were asked to demonstrate how the use of these technologies has extended our knowledge of organisms and then to evaluate the impact of these kinds of technologies on society or human population growth.

Most students were able to identify and describe appropriate technologies. Some students provided specific details of very new and sophisticated technologies. A few students described science fiction-type technologies that do not exist. Many students were not able to demonstrate directly how the use of manipulative or observational technologies has extended our knowledge of organisms. Most presented an unbiased evaluation of the impact of these technologies on society or on human population growth.

Organizational and communication skills were evident in many of the students' responses.

This question was marked holistically. Two markers read each response and each assigned a score from 0 to 4. These scores were added to obtain a raw score from 0 to 8. This raw score was then converted to a mark out of 12. On this 12-mark question, the average mark was 6.82 or 56.8%. On this question, 64.6% of the student population achieved the acceptable standard and 21.7% of the student population achieved the standard of excellence. Of the female students who wrote the examination, 67.0% achieved the acceptable standard and 23.2% achieved the standard of excellence on this question. The average mark on this question for the female population was 58.5%. Of the male students who wrote the examination, 60.9% achieved the acceptable standard and 19.4% achieved the standard of excellence on this question. The average mark on this question for the male population was 54.3%.

For further information, contact Karen Slevinsky or Yvonne Johnson at the Student Evaluation Branch, 403-427-0010.

Distribution of Marks for Question 2